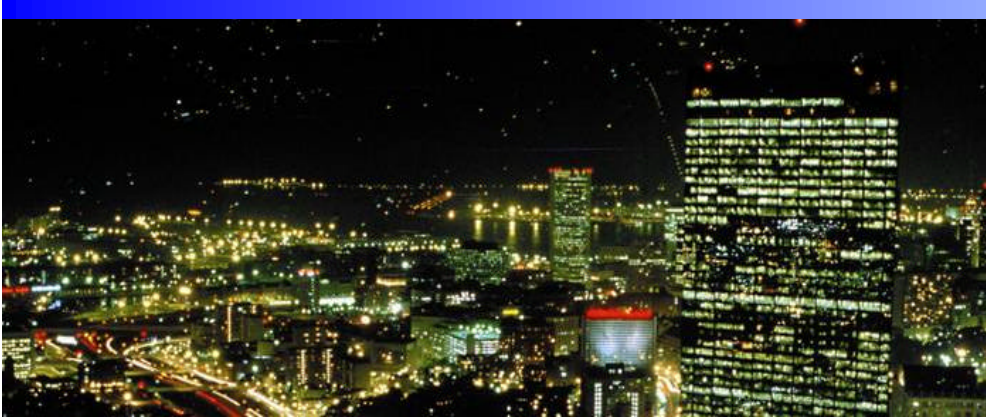


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Energy Efficiency and Renewable Energy



Paul Grabowski
Program Manager

**Office of Biopower
Technologies**



Biomass: The Basic Resource



**Chemical
Products**



Fuels



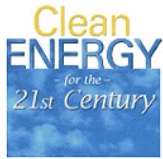
**Electric
Power**



Biopower Mission

Foster the development and use of Biopower technologies which, as part of the EERE Integrated Biomass R&D, will make biomass energy and products competitive with conventional fossil-based options.





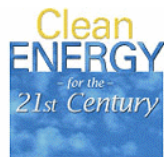
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Program Metrics

- **Comprehensive National Energy Strategy metric**
 - **At least 25 GW of non-hydroelectric renewable generation capacity by 2010**
 - 3 GW_e of new biopower capacity by 2010 for 10 GW_e total biopower capacity



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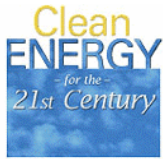
Program Strategy

Technologies

**Success in
Biomass**

Policies

Markets



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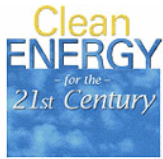
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Markets/Policies

Key Issues:

- **Restructuring: provides opportunity**
- **Tax credits: expand to include other resources**
- **Green power marketing: Renewable Portfolio Standards (RPS) in 11 states and over 20 utilities offer a green power biopower component**
- **Air quality regulations: cost-effective method of emission reductions**



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Markets/Policies

Challenges

- Deregulation pushing down wholesale electricity costs, makes new plants/technologies difficult to start
- Need renewed tax credit for biomass that includes cofiring and open-loop
- Environmental groups do not view biomass as "green"
- EPA may re-examine permits if existing coal plants start cofiring
- Reliable, cost-effective feedstock supply

Opportunities

- Deregulation provides opportunity to promote Biopower through green power sales
- Current tax credit is expanded to include poultry litter
- RPSs in 11 states and over 20 utilities offer a green power biopower component
- Cofiring an inexpensive way to reduce emissions
- Focus on animal waste issues creates markets for small biomass systems

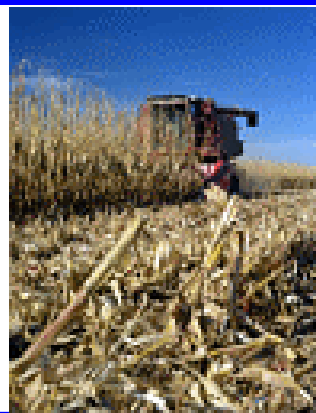


Biomass Feedstocks



Wood Residues

Sawdust
Wood chips
Wood waste
pallets
crate discards
wood yard trimmings



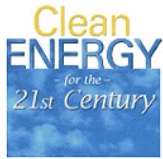
Agricultural Residues

Corn stover
Rice hulls
Sugarcane bagasse
Animal waste



Energy Crops

Hybrid poplar
Switchgrass
Willow
Other



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BioPower Conversion Technologies

Co-Firing

- With Coal or Natural Gas (up to 15%)
- 330 GW of Coal Fired in U.S.

Small, Modular Systems

- Microturbines, Reciprocating Engines, Stirling Engines, Fuel Cells
- Distributed Energy Resources (off-grid)
- Village Power

Gasification

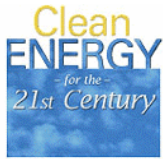
- Natural Gas Turbine
- Byproducts/ Chemicals (Bio-refinery)



Co-firing

- Commercialize and promote biomass co-firing using the least cost approach
- Broaden the base of utilities employing co-firing in existing generating units
- Increase the number and type of technologies used in co-firing





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DOE Co-firing Initiative

- **11 Feasibility Studies**
- **3 NO_x Reduction Studies and Test Data Analyses**
- **4 Utility Demonstration Projects**



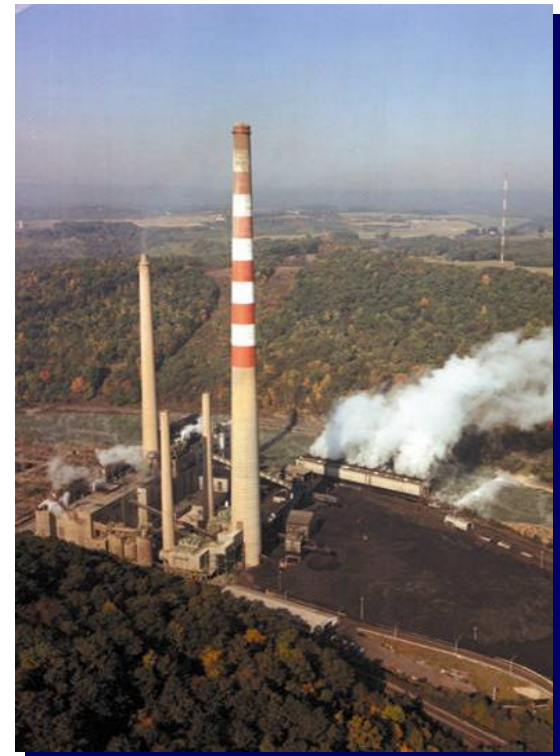
Other Co-firing Projects

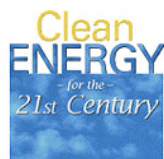
■ Southern Co-firing

- Southern Research Institute/Southern Company, Alabama
- Demonstrate co-firing switchgrass with coal in a full-scale boiler
- Field chopping/co-pulverizing

■ Hawaiian Energy Cane

- HC&S Sugar Mill, Puunene, Maui
- Demonstrate the feasibility/cost-effectiveness of using energy cane as a closed-loop biomass
- Alternate feedstock processing





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Biomass Co-firing Projects

Allegheny Energy	Greensburg, PA	Blend “opportunity fuels” for co-firing. Willow Island & Albright stations
Southern Research Institute	Birmingham, AL	Computer model to calculate energy and benefits from co-firing biomass and coal
Nexant, LLC	San Francisco, CA Henderson, KY	Study the use of poultry litter in a biomass gasification co-firing demonstration
Inst. of Gas Technology & Calla Energy Partners	Des Plaines, IL Lexington, KY	Develop and demonstrate advanced biomass gasification technology
University of Pittsburgh	Pittsburgh, PA	Use sawdust from wood packing crates with coal in the co-firing process
Iowa State University	Ames, IA	Adapt emissions reduction technology to herbaceous biomass when fired with coal
Texas A&M University	College Station, TX	Investigate cattle feedlot and chicken litter biomass co-firing with coal



Rural Development Projects

■ New York Salix (Willow)

- Dunkirk Power Plant
- 10-15 MWe from biomass
- Produce energy crops for power generation in the Northeast and Northern Midwest



■ Iowa Switchgrass

- Ottumwa Generating Station
- Up to 35 MWe from biomass
- Development of markets for energy crops in southern Iowa

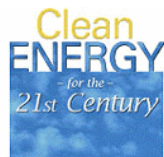


Gasification Project

- Co-funded demonstration of gasification of renewable biomass for electricity production
- Vermont Gasifier Highlights



- Project being undertaken at the existing 50 MW wood-fired McNeil Power Generation Station in Burlington, Vermont
- Gasifier integration with a gas turbine
- “Development and Applications Test Platform” will allow for testing of turbines, fuel cells, other feedstocks and synthetic fuels production, methanol, gasoline, diesel



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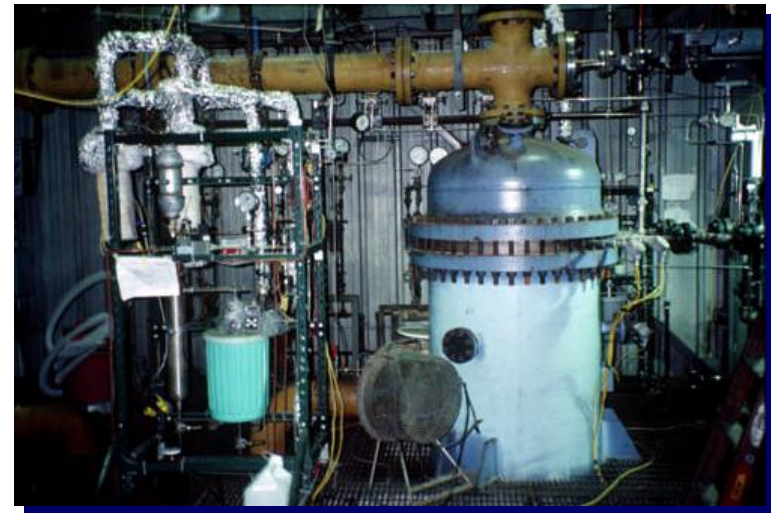
Advanced Biomass Gasification Awards – Sept. 2001 (Phase I)

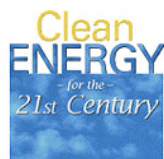
Emery Recycling	Salt Lake City, UT	IGCC and IGFC concepts based on Emery gasifier using segregated MSW, animal wastes, and agricultural residues
Sebesta Blomberg	Roseville, MN	Atmospheric gasification with gas turbine and SI engines at malting facility using barley residues and corn stover
Alliant Energy	Lansing, IA	Combined cycle concept utilizing fluid bed pyrolizer using corn stover
UTRC	East Hartford, CT	Biomass gasifier coupled to aero-derivative turbine with fuel cell and steam turbine options utilizing clean wood residues and NG
CP&L	Raleigh, NC	Biomass gasification to produce a reburning fuel stream for utility boilers utilizing clean wood residues



Modular Systems Project

- Working with industry to develop small, modular biopower systems
- Power range from 5 kW to 5 MW
- Cost-shared contracts awarded in gasification and combustion technologies





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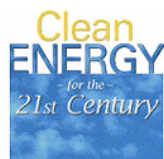
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Small, Modular Biopower Projects

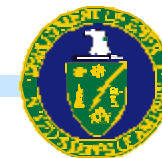
- Completed feasibility studies for 10 small, modular systems
- Current Projects

External Power	Indianapolis, IN	Residential-scale biomass-fueled system using stirling engine developed by Sun Power
Community Power Corporation	Aurora, CO	Gasification with spark ignition engine/generator
Flex Energies Inc.	Mission Viejo, CA	Microturbine for biogas applications
Carbona Corporation	Atlanta, GA	Up-draft gasification with boiler/steam turbine
Cratech	Tahoka, TX	Gasifier with hot gas cleanup system
Camp Lejeune	North Carolina	Fixed-bed gasifier connected to a spark-ignited engine



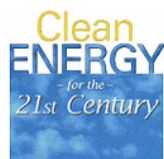
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Small Business Innovation Research Program (SBIR): Biopower

FY 2001 Phase I Awards	<u>Funding (\$K)</u>
Community Power Corporation (CPC)	100
Energy Performance Systems	88.25
Altex Corporation	100
EER-GC Corporation (STTR project)	<u>100</u>
	Total: 388.25
FY 2001 Phase II Awards	
Physical Sciences	750
Spinheat Limited	750
Altex Corporation	712
Energy & Environmental Research	750
MTCI, Inc.	750
Stirling Technology Corporation	<u>749</u>
	Total: 4,461



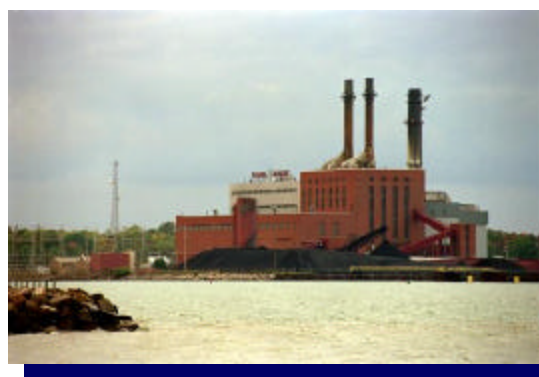
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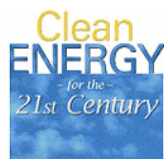
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FY 2002 Program Snapshot: Biopower Systems

	FY2002 Enacted	FY2003 Requested	Change
Program Total	\$39.206M	\$33.000M	- \$6.206M
• Thermochemical Conversion	5.904	6.000	+ 0.096
• Systems Development (Gasification, Small Modular Systems, Rural Development)	29.024	23.625	- 5.399
• Feedstock Production	1.000	1.000	0.0
• Regional Biomass Energy Program	0.778	0.000	- 0.778
• Crosscutting Biomass R&D	2.500	2.375	- 0.125





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Biopower is well-positioned to take advantage of growing environmental and clean energy concerns



Climate Control



Urban Air Quality



Energy Diversity



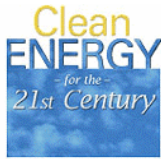
Forest Management



Jobs in Rural Areas



Solid Waste Management



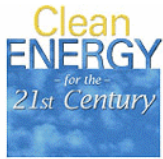
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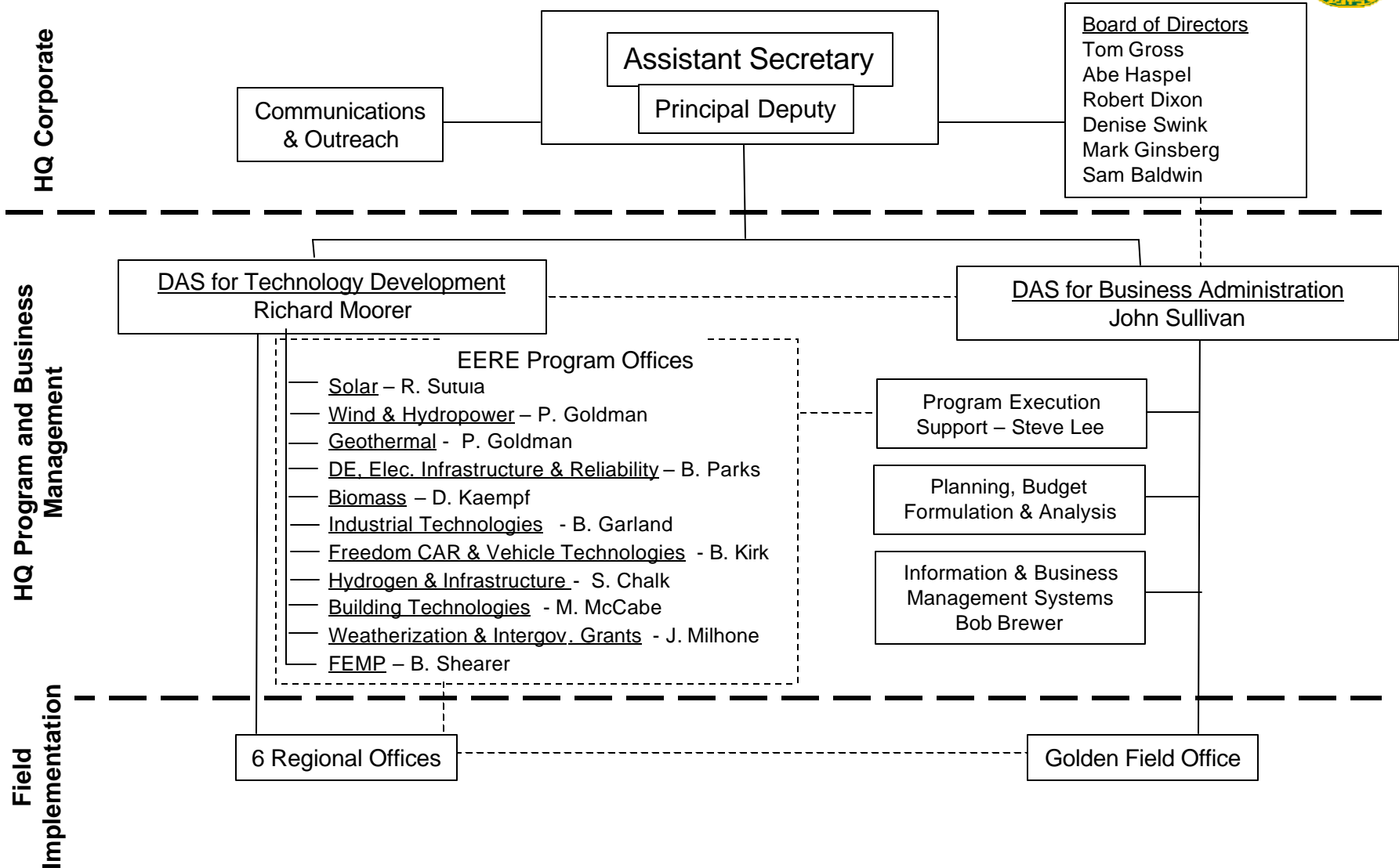
Recent EERE Reorganization

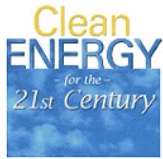
- **WAS – 5 sectors, 17 (+) Technology Offices & multiple BA systems/methods**
- **IS – 2 DAS's & 11 Technology Offices**
- **New "BA" Org will be exclusive source for all business products, processes and systems**
- **This reorganization reflects the NEP and the President's Management Agenda, the OMB R&D criteria, the EERE Strategic Program Review, and other priorities.**



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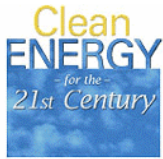
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The EERE Re-org affects Biomass Offices

- **The BioPower, BioFuels Programs & Agricultural and Forreast Products Teams are transitioning to become EERE's
Office of Biomass Program (OBP)**



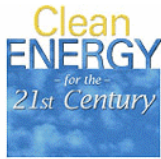
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BioMass Changes as a Result of the Restructured Program

- The Industrial BioRefinery is considered the most promising option for providing fuel, power, and industrial products.
- R&D priorities and funding are focused on the following areas:
 - Feedstock Production
 - Gasification
 - Fuels and Chemicals
 - Processing and Conversion
 - Crosscutting Technologies



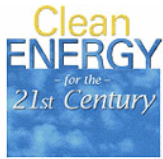
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BioPower Changes as a Result of the Restructured Program

- While cofiring is still part of the program, no new funding will take place since this technology is now considered to be technically viable
- Program elements such as the plant science portion of feedstocks are considered more appropriately performed by other agencies
- Many Regional Biomass Energy Program activities are being transferred to the State Energy Program's solicitation



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DOE's Current Focus Areas

EERE Biomass Program

- Small Modular Biopower Systems
- Gasification of Biomass and Black Liquor (applications for fuel cells)
- Cellulosic Ethanol (Bioethanol)
- Biobased Products
- Improving the Economics of Biorefineries

Office of Science

- Biomaterials and Biocatalysis
- Extremophilic Organisms
- Plant Science
- Fermentation Microbiology

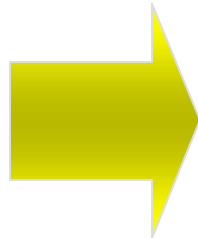


Biobased Products and Bioenergy "Biorefinery"



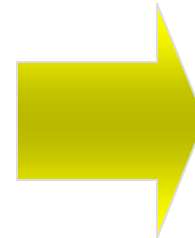
Biomass Feedstock

- Trees
- Grasses
- Agricultural Crops
- Agricultural Residues
- Animal Wastes
- Municipal Solid Waste



Conversion Processes

- Enzymatic Fermentation
- Gas/liquid Fermentation
- Acid Hydrolysis/Fermentation
- Gasification
- Combustion
- Co-firing



USES

Fuels:

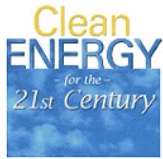
- Ethanol
- Renewable Diesel

Electricity

Heat

Chemicals

- Plastics
- Solvents
- Pharmaceuticals
- Chemical Intermediates
- Phenolics
- Adhesives
- Furfural
- Fatty acids
- Acetic Acid
- Carbon black
- Paints
- Dyes, Pigments, and Ink
- Detergents
- Etc.



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FY 2003 Integrated Budget

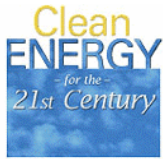
- **Priority Areas for EERE: \$110.5 million**
 - Gasification R&D ~26%
 - Processing & Conversion R&D ~30%
 - Fuels & Chemicals R&D ~38%
- **Office of Science Focus Areas: \$30 million**
 - Plant Science
 - Fermentation Microbiology
 - Extremophilic Organisms
 - Biomaterials and Biocatalysis



Program Benefits (3 E's)

- **Economic Growth**
 - Revitalize rural economies
- **Environmental Stability**
 - Remove biomass residues from the waste stream
 - Improve the environment through reduction in greenhouse gas emissions
- **National Energy Security**





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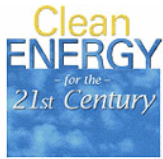
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FY02 Biomass R&D Funding

FY02 Solicitation - \$20M

- <http://www.eren.doe.gov/biopower/main.html>
- **FULL SOLICITATION MUST BE REQUESTED VIA EMAIL FROM Wallace.adcox@mms.gov**
- **Pre-Application must be submitted via e-mail by May 14, 2002**
- **All accepted Pre-Applications must submit a full Application by July 12, 2002.**



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Biomass at Federal Sites

■ **5 Companies Selected**

- **Performance-based contracts to Reduce energy use, Manage utility costs and Promote Biomass and Alternative Methane energy**
 - Constellation Energy Source, Baltimore, Md.
 - DTE Biomass Energy Inc., Ann Arbor, Mich.
 - Energy Systems Group, Evansville, Ind.
 - Systems Engineering and Management Corporation, Knoxville, Tenn.
 - Trigen Development Corporation, Baltimore, Md.

■ **<http://www.eren.doe.gov/femp/financing/espc/biomass.html>**